

# **CRAB AND CLAM SAMPLING AND ANALYSIS**

## **NEWARK BAY STUDY AREA DATA QUALITY USABILITY ASSESSMENT REPORT**

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## **1.0 INTRODUCTION**

In 2014 the United States Environmental Protection Agency (USEPA) approved the Crab and Clam Sampling and Analysis Quality Assurance Project Plan (QAPP), Revision 3a prepared by Tierra Solutions, Inc. (Tierra) for the sampling and analysis of blue crab and softshell clam tissue, and co-located surface sediment in the Newark Bay Study Area. The Crab and Clam Sampling and Analysis QAPP, Revision 3a (Tierra 2014) (hereafter referred to as the QAPP) outlined the crab and clam tissue and sediment sampling and analyses to be conducted for the baseline human health and ecological risk assessment. The crab and clam sampling and analysis activities consisted of the collection and analysis of 111 crab tissue samples, 18 clam tissue samples, and 19 sediment samples (includes quality control samples). According to Worksheet #37 of the QAPP, (Tierra 2014) a Data Quality Usability Assessment Report (DQUAR) must be completed after the conclusion of validation tasks.

In accordance with requirements of the QAPP, the data quality usability assessment was conducted on both verified and validated data; this DQUAR provides a summary of the evaluation of data quality and usability for sample data collected during implementation of the Crab and Clam Sampling and Analysis QAPP. The data verification and data validation processes are described respectively in Worksheets #34 and #35 of the QAPP.

Worksheet #37 of the QAPP provides a description of the components of the DQUAR. These components are described in detail in subsequent sections of this report.

## **2.0 DATA QUALITY PARAMETERS OVERVIEW**

To assess whether the analytical data obtained were consistent with the objectives of the QAPP, seven data quality parameters were evaluated. In the event that the data verification/validation process identified an instance where any of the data quality parameters did not meet the objectives established in the QAPP, the affected sample results were evaluated in accordance with the data verification/validation protocols specified in Worksheet #34 and Worksheet #35 of the QAPP and documented accordingly. A detailed narrative describing the verification/validation assessments and findings can be found within the data verification/validation data assessment narratives prepared for each data package.

The seven data quality parameters assessed included the following:

- precision;
- accuracy/bias contamination;
- overall accuracy/bias;
- sensitivity;
- representativeness;
- comparability; and
- completeness.

Each of these data quality parameters, as it relates to the QAPP program, is discussed below.

### **2.1 PRECISION**

Precision is the measure of variability between individual sample measurements of the same property under similar conditions. During the crab and clam program, precision was evaluated through the analysis of two types of duplicate samples. Field and laboratory duplicates were analyzed at regular, specified intervals throughout the Crab and Clam Sampling and Analysis program.

Field duplicates consisted of samples that were collected in the field at the frequency specified in the QAPP in order to determine the precision of field sampling methods. Duplicate samples were collected as two distinct samples, and submitted “blind” to the analytical laboratories for analysis (i.e., the sample identification did not reveal the sample with which its field duplicate was associated). Field duplicates were only applicable to sediment samples. Due to limited clam and crab tissue mass, only laboratory replicates were collected for these tissue matrices. Field duplicates for the tissue matrix were included for fish tissue samples, where more mass was available for quality control samples.

Relative percent differences (RPDs) between the field sample results and the field duplicate results provide an estimate of the overall sampling and analytical precision.

Laboratory duplicates are two portions of a single homogeneous sample that are analyzed for the same parameter in order to determine the precision of the analytical system. Two types of laboratory duplicates were prepared. Laboratory duplicates without known analyte spikes added were analyzed

to monitor laboratory precision for inorganics, while matrix spike (MS) and matrix spike duplicate (MSD) evaluations were performed to monitor laboratory precision for the remaining analysis types. Laboratory duplicates were analyzed at the frequency specified in QAPP. The RPD between results obtained for a given laboratory duplicate pair provides an estimate of analytical precision.

The precision assessment for field and laboratory duplicate analyses is expressed as the RPD:

$$\text{RPD} = \{(S-D)/(S+D)/2\} \times 100$$

Where:

**S = original sample concentration**

**D = duplicate sample concentration**

Acceptance criteria for field and laboratory duplicates are provided in Worksheets #12-2 and #12-3 of the QAPP. Conformance to laboratory duplicate frequency requirements, as well as acceptability of the resulting RPD values, were evaluated and considered during data validation.

Although laboratory duplicate analyses are used as indicators of relative precision of the analytical systems, the degree of homogeneity of the contaminants in the sample medium can also affect the reproducibility of a particular measurement. For example, pieces of decayed wood debris, chunks of asphalt, glass, free product, etc., can increase sample heterogeneity and therefore can reduce the laboratory technician's ability to create homogeneous duplicate samples with which to measure precision. Since the sample matrix characteristics can affect the way precision is measured, the sample matrix should be considered by the validator.

With respect to the results of the crab and clam program data, there are no limitations on data usage based on precision quality acceptance criteria. The following table summarizes the precision quality evaluation by analytical group and sampling technique. The "x" designation indicates that an issue was identified however; such issue does not infer that the data are unusable. A more detailed discussion of this data quality parameter evaluation is provided in Section 3.1 of this report.

PRECISION			
Analytical Groups	Crab Tissue	Clam Tissue	Sediment
Semivolatile Organics	v	v	v
Volatile Organics	-	-	v
Aroclor PCBs	x	x	x
Butyltins	v	v	v
Organochlorine Pesticides	x	x	x
Saturated Hydrocarbons	-	-	x
Semivolatile Organics (SIM)	v	v	x
Metals (including SEM)	x	x	x
Titanium	v	v	x
Mercury	v	v	x
Methylmercury	x	v	x
Cyanide	-	-	x
Hexavalent Chromium	-	-	v
Sulfide	-	-	x
PCDDs/PCDFs	v	v	x
PCB Congeners	x	v	x
Chlorinated Herbicides	-	-	x
TOC	-	-	v
ORP	-	-	x
TEPH	-	-	v
Total Phosphorus	-	-	x
Acid Volatile Sulfide	-	-	x
Total Kjeldahl Nitrogen	-	-	x
Ammonia Nitrogen	-	-	v
pH	-	-	v
Grain Size	-	-	v

- = analysis was not performed for this analytical group
- x = data qualified due to precision during validation for this analytical group
- v = no data qualifications due to precision were made for this analytical group

## 2.2 ACCURACY/BIAS CONTAMINATION

Accuracy parameters were also assessed with respect to contamination through the use of field and laboratory blanks. Any contamination present in field or laboratory blanks reflects the potential for contamination in associated samples. Measurement performance criteria for accuracy/bias contamination are outlined in Worksheets #12-1, #12-2, and #12-3 of the QAPP. Acceptability of quality control (QC) results for accuracy/bias contamination and conformance to field and laboratory QC sample frequency requirements were evaluated and considered during the data verification/validation.

With respect to the results of the crab and clam program data, there are no limitations on the data usage based on accuracy/bias contamination acceptance criteria. The following table summarizes the accuracy/bias contamination quality evaluation by analytical group and sampling technique. The “x” designation indicates that an issue was identified however; such issue does not infer that the data are unusable. A more detailed discussion of this data quality parameter evaluation is provided in Section 3.1 of this report.

ACCURACY/BIAS CONTAMINATION			
Analytical Groups	Crab Tissue	Clam Tissue	Sediment
Semivolatile Organics	v	v	x
Volatile Organics	-	-	v
Aroclor PCBs	v	v	v
Butyltins	v	v	v
Organochlorine Pesticides	x	x	x
Saturated Hydrocarbons	-	-	v
Semivolatile Organics (SIM)	v	v	v
Metals (including SEM)	x	v	v
Titanium	x	v	v
Mercury	v	v	v
Methylmercury	v	v	v
Cyanide	-	-	v
Hexavalent Chromium	-	-	v
Sulfide	-	-	v
PCDDs/PCDFs	v	v	x
PCB Congeners	x	x	x
Chlorinated Herbicides	-	-	v
TOC	-	-	v
ORP	-	-	v
TEPH	-	-	v
Total Phosphorus	-	-	v
Acid Volatile Sulfide	-	-	v
Total Kjeldahl Nitrogen	-	-	v
Ammonia Nitrogen	-	-	v
pH	-	-	v
Grain Size	-	-	v

- = analysis was not performed for this analytical group

x = data qualified due to accuracy/bias contamination during validation for this analytical group

v = no data qualifications due to accuracy/bias contamination were made for this analytical group

## 2.3 OVERALL ACCURACY/BIAS

Accuracy is a measure of the bias and precision in a system, and is defined as the agreement between a measurement and an accepted reference or true value. Pre-mobilization performance evaluation samples were analyzed prior to initiating field work. Documentation of successful analysis of the performance evaluation samples was provided to the United States Environmental Protection Agency (USEPA) by Tierra Solutions, Inc. Accuracy was monitored during the crab and clam program through the analysis of MSs, surrogate spikes, and laboratory control samples (LCSs) (performed at regular, specified intervals).

As outlined in the QAPP, the analysis of MS samples and LCSs provide laboratory results that may be compared to their associated known values to monitor potential bias. The MS and surrogate spike evaluations were used to assess bias by monitoring the actual recovery of a known quantity of a chemical, added to the native sample, versus the expected recovery. The LCS evaluations were used to assess bias by monitoring the actual recovery of a known quantity of a chemical, added to a blank, versus the expected recovery.

Acceptance criteria for each of the Accuracy evaluations described above are provided in Worksheets #12-1, #12-2, and #12-3 of the QAPP. Conformance to laboratory QC sample frequency requirements, as well as acceptability of QC results for accuracy, were evaluated and considered during data verification/validation.

Data for several analytical groups associated with multiple sampling techniques were determined to be unusable due to severe accuracy/bias issues. The following table summarizes the overall accuracy/bias quality evaluation by analytical group and sampling technique. The “x” designation indicates that an issue was identified however; such issue does not infer that the data are unusable. A more detailed discussion of this data quality parameter evaluation is provided in Section 3.1 of this report.

OVERALL ACCURACY/BIAS			
Analytical Groups	Crab Tissue	Clam Tissue	Sediment
Semivolatile Organics	x	x	x
Volatile Organics	-	-	x
Aroclor PCBs	x	v	x
Butyltins	x	x	v
Organochlorine Pesticides	x	x	x
Saturated Hydrocarbons	-	-	x
Semivolatile Organics (SIM)	x	x	x
Metals (including SEM)	x	x	x
Titanium	v	v	x
Mercury	v	v	v
Methylmercury	x	x	x
Cyanide	-	-	v
Hexavalent Chromium	-	-	x
Sulfide	-	-	x
PCDDs/PCDFs	x	x	x
PCB Congeners	x	x	x
Chlorinated Herbicides	-	-	x
TOC	-	-	x
ORP	-	-	v
TEPH	-	-	x
Total Phosphorus	-	-	x
Acid Volatile Sulfide	-	-	x
Total Kjeldahl Nitrogen	-	-	x
Ammonia Nitrogen	-	-	x
pH	-	-	v
Grain Size	-	-	v

- = analysis was not performed for this analytical group

x = data qualified due to overall accuracy/bias during validation for this analytical group

v = no data qualifications due to overall accuracy/bias were made for this analytical group



## 2.4 SENSITIVITY

Sensitivity is related to the ability to compare analytical results with project quantitation limits (PQLs). Analytical detection limits should be at or below the PQLs to allow effective comparisons. All sample analytical results reported during the crab and clam program were evaluated to determine if adequate sensitivity was achieved. The results for each analyte were cross-checked against the PQLs presented in Worksheets #15-1, #15-2, and #15-3 of the QAPP. The QAPP's PQLs were set equal to the laboratory achievable quantitation limit, and any dilution or adjustment in initial extraction mass by the laboratory would cause the quantitation limit to be higher than the achievable quantitation limit. The tables in Section 2.4.1 below summarize the percent of sample results that did not meet the data quality objectives as defined by the QAPP. The percentages expressed in these tables indicate the fraction of the total number of results reported for each analytical group and sampling technique where reporting limits exceeded the PQLs. The data results reported in the tables below are the laboratory qualified results and not from the validation qualified results.

With respect to the results of the crab and clam program data, there are no limitations on the data usage based on sensitivity acceptance criteria. A more detailed discussion of this data quality parameter evaluation is provided in Section 2.4.1.

### 2.4.1 Achieved Analytical Sensitivity

The fact that data failed to meet established PQLs for specific analytical groups as indicated in the tables below, may have impacted the number of positive results identified in those samples, thereby potentially impacting the data evaluation process. Following each table is a discussion of the analytical groups for which failure to meet the PQLs, may have impacted the data evaluation.

#### Crab Tissue

Table 2-1  
 Sensitivity Quality Evaluation for Crab Tissue Samples

Analytical Group	Total Number of Results Reported	Non-detected Results with PQLs Greater than those Defined in the Crab and Clam QAPP	Detected Results Between the MDL (or EDL where appropriate) and Elevated PQL	Total non-detect results greater than PQL / Total Results Reported
Semivolatile Organics	5883	3663	60	3663/5883
Aroclor PCBs	999	308	38	308/999
Butyltins	444	2	0	2/444
Organochlorine Pesticides	3219	63	276	63/3219
Semivolatile Organics SIM	4218	262	430	262/4218
Metals	2442	0	258	0/2442
Titanium	111	0	70	0/111
Mercury	111	0	0	0/111
Methylmercury	111	0	0	0/111
PCDDs/PCDFs	1887	0	1402	0/1887
PCB Congeners	18648	1616	1556	1616/18648

For the crab tissue results, PQLs identified in Table 2-1 above as greater than those defined in the QAPP were exceeded to varying degrees, mainly due to either sample dilution prior to analysis, or use of less than targeted sample volume for analysis.

### **Clam Tissue**

**Table 2-2**  
**Sensitivity Quality Evaluation for Clam Tissue Samples**

<b>Analytical Group</b>	<b>Total Number of Results Reported</b>	<b>Non-detected Results with PQLs Greater than those Defined in the Crab and Clam QAPP</b>	<b>Detected Results Between the MDL (or EDL where appropriate) and Elevated PQL</b>	<b>Total non-detect results greater than PQL / Total Results Reported</b>
Semivolatile Organics	9548	0	24	0/9548
Aroclor PCBs	162	0	16	0/162
Butyltins	72	0	0	0/72
Organochlorine Pesticides	522	5	70	5/522
Semivolatile Organics SIM	684	0	96	0/684
Metals	396	0	27	0/396
Titanium	18	0	0	0/18
Mercury	18	0	0	0/18
Methylmercury	18	0	0	0/18
PCDDs/PCDFs	306	0	232	0/306
PCB Congeners	3024	0	129	0/3024

For the clam tissue results, PQLs identified in Table 2-2 above as greater than those defined in the QAPP were exceeded to varying degrees, mainly due to either sample dilution prior to analysis, or use of less than targeted sample volume for analysis.

## **Sediment**

**Table 2-3**  
**Sensitivity Quality Evaluation for Sediment Samples**

<b>Analytical Group</b>	<b>Total Number of Results Reported</b>	<b>Non-detected Results with PQLs Greater than those Defined in the Crab and Clam QAPP</b>	<b>Detected Results Between the MDL (or EDL where appropriate) and Elevated PQL</b>	<b>Total non-detect results greater than PQL / Total Results Reported</b>
Semivolatile Organics	1007	928	27	928/1007
Volatile Organics	76	0	0	0/76
Aroclor PCBs	171	8	14	8/171
Butyltins	76	63	0	63/76
Organochlorine Pesticides	551	41	26	41/551
Saturated Hydrocarbons	665	189	125	189/665
Semivolatile Organics SIM	722	0	18	0/722
Metals (including SEM)	532	0	31	0/532
Titanium	19	0	0	0/19
Mercury	19	0	4	0/19
Methylmercury	19	0	0	0/19
Cyanide	19	0	0	0/19
Hexavalent Chromium	19	17	1	17/19
Sulfide	19	0	0	0/19
PCDDs/PCDFs	323	0	133	0/323
PCB Congeners	3192	448	308	448/3192
TOC	19	0	0	0/19
TEPH	19	0	4	0/19
Total Phosphorus	19	0	0	0/19
Acid Volatile Sulfide	19	0	5	0/19
Total Kjeldahl Nitrogen	19	0	0	0/19
Chlorinated Herbicide	76	4	3	4/76
Ammonia Nitrogen	19	18	1	18/19

For the sediment results, PQLs identified in Table 2-3 above as greater than those defined in the QAPP were exceeded to varying degrees, mainly due to either sample dilution prior to analysis, or use of less than targeted sample volume for analysis.

## **2.5 REPRESENTATIVENESS**

Representativeness is the degree to which a data set accurately represents the characteristics of a population, parameter conditions at a sample point, or an environmental condition. Data are representative when all sampling and analyses are performed in compliance with appropriate procedures. Performing sample analyses within the specified holding times and adhering to sample handling and storage requirements are also critical elements in obtaining representative sample data. These elements were evaluated and considered during data verification/validation. Acceptance criteria for sample handling, storage and holding times are provided in Worksheets #19-3 and #19-7 of the QAPP.

With respect to the results of the crab and clam program data, there are no limitations on the data usage based on representativeness acceptance criteria. The following table summarizes the

representativeness quality evaluation by analytical group and sampling technique. The “x” designation indicates that an issue was identified however; such issue does not infer that the data are unusable. A more detailed discussion of this data quality parameter evaluation is provided in Section 3.1 of this report. Data were qualified for representativeness due to holding time violations.

HOLDING TIME VIOLATIONS			
Analytical Groups	Crab Tissue	Clam Tissue	Sediment
Semivolatile Organics	x	v	v
Volatile Organics	-	-	v
Aroclor PCBs	v	v	v
Butyltins	v	v	x
Organochlorine Pesticides	x	v	v
Saturated Hydrocarbons	-	-	x
Semivolatile Organics (SIM)	v	v	v
Metals	v	v	v
Titanium	v	v	v
Mercury	v	v	v
Methylmercury	v	v	v
Cyanide	-	-	v
Hexavalent Chromium	-	-	v
Sulfide	-	-	x
PCDDs/PCDFs	v	v	v
PCB Congeners	x	v	x
Chlorinated Herbicides	-	-	v
TOC	-	-	v
ORP	-	-	v
TEPH	-	-	v
Total Phosphorus	-	-	v
Acid Volatile Sulfide	-	-	v
Total Kjeldahl Nitrogen	-	-	v
Ammonia Nitrogen	-	-	v
pH	-	-	v
Grain Size	-	-	v

- = analysis was not performed for this analytical group

x = data qualified due to holding time violations during validation for this analytical group

v = no data qualifications due to holding time violations were made for this analytical group

## 2.6 COMPARABILITY

Comparability expresses the confidence with which one set of data can be compared to another to measure the same property. Data can be compared to the degree that their accuracy, precision, and representativeness are known and documented. Data are comparable if QC measures such as collection techniques, measurement procedures, analytical methods, and reporting units are equivalent

for the samples within a sample set. Data subject to established quality assurance/quality control (QA/QC) measures are deemed more reliable and, therefore, more comparable, than data generated without such measures.

Consistent application of prescribed procedures was monitored throughout the crab and clam program. Likewise, specific data verification/validation protocols were consistently applied to all data generated under this program to understand and document accuracy/bias, accuracy/bias contamination, precision, sensitivity and representativeness, thereby establishing comparability as defined above.

During data validation activities, analytical data were evaluated using a defined set of guidelines and acceptance criteria. In addition, data validation qualifiers were consistently applied to the analytical data generated during the crab and clam program. The data validation process serves to increase the degree of data comparability achieved.

With respect to the results of the crab and clam program data, there are no limitations on the data usage based on comparability acceptance criteria.

## 2.7 FIELD AND ANALYTICAL COMPLETENESS

There are two measures of completeness defined for the crab and clam program: field completeness and analytical completeness. Field completeness is defined as the ratio of the number of samples received in acceptable condition by the laboratories to the number of samples planned to be collected as specified in the QAPP. Analytical completeness is defined as the ratio of total analytical data results reported to the total number of analytical results requested on samples submitted for analysis. The formulas used to compute field and analytical completeness are presented below.

$$\% \text{ Field Completeness} = (\text{Number of Samples [field samples and field duplicates] Received by Laboratories} / \text{Total Number of Samples [field samples and field duplicates] Planned to be collected}) \times 100$$
$$\% \text{ Analytical Completeness} = (\text{Total Valid Analytical Data} / \text{Analytical Data Obtained}) \times 100$$

The targeted field and analytical completeness goals were 90% for the crab and clam program; these goals were met, or exceeded, as summarized below.

<b>Crab and Clam Completeness</b>	<b>Completeness Goal Established in Crab and Clam QAPP</b>	<b>Crab and Clam Completeness Achieved</b>
Field Completeness (Overall)	90%	100%
Analytical Completeness (Overall)	90%	98%

**Crab and Clam  
 Field Completeness by Analysis and Sample Type**

Analytical Group	Number of Samples Collected by Sample Type			Total Number of Samples Collected	Total Number of Samples Planned	Completeness Achieved (%)
	Crab Tissue	Clam Tissue	Sediment			
Semivolatile Organics	111	18	19	148	148	100
Volatile Organics	0	0	19	19	19	100
Aroclor PCBs	111	18	19	148	148	100
Butyltins	111	18	19	148	148	100
Organochlorine Pesticides	111	18	19	148	148	100
Saturated Hydrocarbons	0	0	19	19	19	100
Semivolatile Organics (SIM)	111	18	19	148	148	100
Metals (including SEM)	111	18	19	148	148	100
Titanium	111	18	19	148	148	100
Mercury	111	18	19	148	148	100
Methylmercury	111	18	19	148	148	100
Cyanide	0	0	19	19	19	100
Hexavalent Chromium	0	0	19	19	19	100
Sulfide	0	0	19	19	19	100
PCDDs/PCDFs	111	18	19	148	148	100
PCB Congeners	111	18	19	148	148	100
Chlorinated Herbicides	0	0	19	19	19	100
TOC	0	0	19	19	19	100
ORP	0	0	19	19	19	100
TEPH	0	0	19	19	19	100
Total Phosphorus	0	0	19	19	19	100
Acid Volatile Sulfide	0	0	19	19	19	100
Total Kjeldahl Nitrogen	0	0	19	19	19	100
Ammonia Nitrogen	0	0	19	19	19	100
pH	0	0	19	19	19	100
Grain Size	0	0	19	19	19	100

Note: Sediment number of samples listed includes quality control sample

Crab and Clam Analytical Completeness by Analysis	Overall Completeness Achieved
<b>Chemical Analyses</b>	
Semivolatile Organics	99.3%
Volatile Organics	100%
Aroclor PCBs	100%
Butyltins	99.3%
Organochlorine Pesticides	95.7%
Saturated Hydrocarbons	100%
Semivolatile Organics (SIM)	100%
Metals (including SEM)	100%
Titanium	100%
Mercury	100%
Methylmercury	98%
Cyanide	100%
Hexavalent Chromium	63.2%
Sulfide	94.7%
PCDDs/PCDFs	99.8%
PCB Congeners	96.9%
Chlorinated Herbicides	100%
TOC	100%
ORP	100%
TEPH	100%
Total Phosphorus	100%
Acid Volatile Sulfide	89.5%
Total Kjeldahl Nitrogen	94.7%
Ammonia Nitrogen	84.2%
pH	100%
Grain Size	100%

**Crab and Clam Analytical Completeness by Analysis and Sample Type**

**Crab Tissue**

<b>Analytical Group</b>	<b>Samples Analyzed</b>	<b>Analytes per Sample</b>	<b>Total Results</b>	<b>Rejected Results</b>	<b>Analytical Completeness Achieved</b>
Semivolatile Organics	111	53	5883	53	99.1%
Aroclor PCBs	111	9	999	0	100%
Butyltins	111	4	444	4	99.1%
Organochlorine Pesticides	111	29	3219	177	94.5%
Semivolatile Organics (SIM)	111	38	4218	0	100%
Metals	111	22	2442	0	100%
Titanium	111	1	111	0	100%
Mercury	111	1	111	0	100%
Methylmercury	111	1	111	3	97.3%
PCDDs/PCDFs	111	17	1887	0	100%
PCB Congeners	111	168	18648	734	96.1%
Total Crab Tissue	1221	-	38073	971	97.5%

**Clam Tissue**

<b>Analytical Group</b>	<b>Samples Analyzed</b>	<b>Analytes per Sample</b>	<b>Total Results</b>	<b>Rejected Results</b>	<b>Analytical Completeness Achieved</b>
Semivolatile Organics	18	53	954	0	100%
Aroclor PCBs	18	9	162	0	100%
Butyltins	18	4	72	0	100%
Organochlorine Pesticides	18	29	522	7	98.7%
Semivolatile Organics (SIM)	18	38	684	0	100%
Metals	18	22	396	0	100%
Titanium	18	1	18	0	100%
Mercury	18	1	18	0	100%
Methylmercury	18	1	18	0	100%
PCDDs/PCDFs	18	17	306	1	99.7%
PCB Congeners	18	168	3024	46	98.5%
Total Clam Tissue	198	-	6174	54	99.1%



### **Sediment**

<b>Analytical Group</b>	<b>Samples Analyzed</b>	<b>Analytes per Sample</b>	<b>Total Results</b>	<b>Rejected Results</b>	<b>Analytical Completeness Achieved</b>
Semivolatile Organics	19	53	1007	0	100%
Volatile Organics	19	4	76	0	100%
Aroclor PCBs	19	9	171	0	100%
Butyltins	19	4	76	0	100%
Organochlorine Pesticides	19	29	551	0	100%
Saturated Hydrocarbons	19	35	665	0	100%
Semivolatile Organics (SIM)	19	38	722	0	100%
Metals (including SEM)	19	28	532	0	100%
Titanium	19	1	19	0	100%
Mercury	19	1	19	0	100%
Methylmercury	19	1	19	0	100%
Cyanide	19	1	19	0	100%
Hexavalent Chromium	19	1	19	7	63.2%
Sulfide	19	1	19	1	94.7%
PCDDs/PCDFs	19	17	323	4	98.8%
PCB Congeners	19	168	3192	0	100%
Chlorinated Herbicides	19	4	76	0	100%
TOC	19	1	19	0	100%
ORP	19	1	19	0	100%
TEPH	19	1	19	0	100%
Total Phosphorus	19	1	19	0	100%
Acid Volatile Sulfide	19	1	19	2	89.5%
Total Kjeldahl Nitrogen	19	1	19	1	94.7%
Ammonia Nitrogen	19	1	19	3	84.2%
pH	19	1	19	0	100%
Grain Size	19	17	323	0	100%
Total Sediment	494	-	7980	18	99.8%

Note: Sediment number of samples listed includes quality control sample

The analytical completeness achieved for total crab tissue was 97.5%. The analytical completeness achieved for total clam tissue was 99.1%. The analytical completeness for total sediment was. 99.8%. The total analytical completeness for all matrices analyzed is 98%.

### 3.0 CRAB AND CLAM PROGRAM DATA VERIFICATION/VALIDATION

Crab and clam program analytical results were provided by the laboratories both electronically and in hard copy format. Upon receipt from the laboratory, results for specific analytical groups described below were verified or validated by Field and Technical Services, LLC. (FTS) using the following:

Semivolatile Organics	USEPA Region 2 SOP HW-22, Revision 3, 10/06
Volatile Organics	USEPA Region 2 SOP HW-24, Revision 1, 6/99
Aroclor PCBs	USEPA Region 2 SOP HW-37, Revision 1, 8/07
Butyltins	EDS SOP: Organotins Prep. 8/05
Organochlorine Pesticides	EDS SOP Organochlorine Pesticides by HRGC/HRMS USEPA 1699, Rev.0, 7/10
Saturated Hydrocarbons	EDS SOP: TEPH-01 Rev. 3, 07/07
Semivolatile Organics (SIM)	USEPA Region 2 SOP HW-35, Revision 2, 3/13
Metals (including SEM)	USEPA Region 2 SOP HW-2b, Rev. 15, 12/12
Titanium	USEPA Region 2 SOP HW-2a, Rev. 15, 12/12
Mercury	EDS SOP: Mercury by CVAFS USEPA 1631, Rev. 1, 5/14
Methylmercury	EDS SOP: Methyl Mercury by CVAFS USEPA 1630, Rev. 1, 5/14
Cyanide	USEPA Region 2 SOP HW-2c, Revision 15, 12/12
Hexavalent Chromium	NJDEP SOP for Analytical Data Validation of Hexavalent Chromium, 5.A.10, Rev. 2, 8/05
Sulfide	EDS SOP: V-12 Rev. 0, 1/09
PCDDs/PCDFs	USEPA Region 2 SOP HW-25, Revision 3, 12/10
PCB Congeners	EDS SOP: Congener PCB, Rev. 3, 7/10
Chlorinated Herbicides	USEPA Region 2 SOP HW-17, Revision 3, 7/08
TOC	EDS SOP: TOC-01 Rev. 2, 7/10
Oxidation Reduction Potential	EDS SOP: ORP, Rev. 0, 7/14
TEPH	EDS SOP: TEPH-01 Rev. 3, 07/07
Total Phosphorus	USEPA Inorganic Data Review, OSWER 9240.1-51 EPA-540-R-10-011, 01/10
Acid Volatile Sulfide	USEPA Inorganic Data Review, OSWER 9240.1-51 EPA-540-R-10-011, 01/10
Total Kjeldahl Nitrogen	USEPA Inorganic Data Review, OSWER 9240.1-51 EPA-540-R-10-011, 01/10
Ammonia Nitrogen	USEPA Inorganic Data Review, OSWER 9240.1-51 EPA-540-R-10-011, 01/10
pH	USEPA Inorganic Data Review, OSWER 9240.1-51 EPA-540-R-10-011, 01/10
Grain Size	EDS SOP-14, Revision 2 – Verification/Validation Geotechnical Data

The verification/validation standard operating procedures (SOPs), as referenced above, are provided in Appendix N of the QAPP. The data verification/validation process is detailed in Worksheets #34, #35, and #36 of the QAPP.

### 3.1 DATA QUALITY ISSUES

Two types of data quality issues are discussed in this section; systematic data quality issues and random data quality issues. Systematic data quality issues are those that are identified as having a consistent impact on the quality of results reported (i.e., data quality of all samples and/or analytical groups are affected by a single data quality issue), due to a common circumstance or procedural application. Systematic data quality issues are described in Section 3.1.1. Random data quality issues are those that do not have a consistent impact on the quality of results (i.e., data quality for a specific sample(s) and/or analyte(s) are affected by the data quality issue). Random data quality issues are presented in Sections 3.1.2.

Section 3.1.2 summarizes the data validation findings related to random data quality issues for each analytical group. These validation findings have been separated into two distinct categories, major data quality issues and minor data quality issues. Major data quality issues are those that result in the qualification of the analytical value reported as “R”, or rejected. This occurs due to the presence of significant QA/QC problems that render the analysis invalid and the results unusable. Minor data quality issues include all other QA/QC problems identified during the data validation process that require sample results to be qualified, indicating some level of uncertainty associated with the reported result.

Conclusions based on the information presented in these summaries can be found in Section 4 of this report.

### 3.1.1 Crab and Clam Tissue and Sediment Samples Systematic Data Quality Issues

No systematic data quality issues were identified during the crab and clam program sample validation task.

### 3.1.2 Crab and Clam Tissue and Sediment Samples Random Data Quality Issues by Analytical Group

#### Semivolatile Organic Compounds

The crab and clam program sample SVOC dataset is comprised of 111 crab tissue samples with 5883 associated results, 18 clam tissue samples with 954 associated results, and 19 sediment samples with 1007 associated results.

One major data quality issue was identified during validation of the crab and clam program SVOC analyses. The identified major data quality issue is described in the table below.

Eight minor data quality issues were identified in the crab and clam program SVOC dataset. The identified minor data quality issues are described in the tables below.

Major Data Quality Issues					
Semivolatile Crab Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of SVOC Results Affected
Non-compliant project specific surrogate recovery, as specified by USEPA Region 2	Overall Accuracy/Bias	5883	1	53	0.90

Minor Data Quality Issues					
Semivolatile Crab Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of SVOC Results Affected
Non-compliant continuing calibration percent difference	Overall Accuracy/Bias	5883	59	134	2.28
Non-compliant initial calibration relative percent difference	Overall Accuracy/Bias	5883	4	4	0.69
Non-compliant laboratory control sample	Overall Accuracy/Bias	5883	29	29	0.49
Non-compliant internal standard recovery	Overall Accuracy/Bias	5883	5	104	1.77
Non-compliant project specific surrogate recovery, as specified by USEPA Region 2	Overall Accuracy/Bias	5883	2	106	1.80
Non-compliant holding time	Representativeness	5883	1	53	0.90

Minor Data Quality Issues					
Semivolatile Clam Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of SVOC Results Affected
Non-compliant initial calibration relative percent difference	Overall Accuracy/Bias	954	15	15	1.57
Non-compliant laboratory control sample	Overall Accuracy/Bias	954	15	15	1.57
Non-compliant project specific surrogate recovery, as specified by USEPA Region 2	Overall Accuracy/Bias	954	1	53	5.56

Minor Data Quality Issues					
Semivolatile Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of SVOC Results Affected
Laboratory blank contamination	Accuracy/Bias Contamination	1007	3	3	0.30
Non-compliant initial calibration relative percent difference	Overall Accuracy/Bias	1007	4	10	0.99
Received outside of temperature range	Overall Accuracy/Bias	1007	3	159	15.8

As stated in the table above for major data quality issues, 53 SVOC results were rejected due to surrogate recovery. Surrogate recoveries which resulted in major data quality issues (rejected) fell below 10% recovery.

## Volatile Organic Compounds

The crab and clam program VOC dataset is comprised of 19 sediment samples with 76 associated results.

No major data quality issues were identified during validation of the crab and clam program VOC analyses.

Four minor data quality issues were identified during validation of the crab and clam program VOC analyses. The identified minor data quality issues are described in the table below.

Minor Data Quality Issues					
VOC Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of VOC Results Affected
Non-compliant matrix spike/matrix spike duplicate relative percent difference	Overall Accuracy/Bias	76	1	3	3.95
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	76	1	4	5.26
Non-compliant internal standard recovery	Overall Accuracy/Bias	76	1	4	5.26
Received outside of temperature range	Overall Accuracy/Bias	76	3	12	15.8

## Aroclor Polychlorinated Biphenyls

The crab and clam program Aroclor PCB dataset is comprised of 111 crab tissue samples with 999 associated results, 18 clam tissue samples with 162 associated results, and 18 sediment samples with 171 associated results.

No major data quality issues were identified during validation of the crab and clam program Aroclor PCB analyses.

Five minor data quality issues were identified in the crab and clam program Aroclor PCB dataset. The identified minor data quality issues are described in the tables below.

Minor Data Quality Issues					
Aroclor PCBs Crab Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Aroclor PCB Results Affected
Non-compliant aroclor identification percent difference	Precision	999	4	4	0.40
Non-compliant matrix spike/matrix spike duplicate relative percent difference	Precision	999	1	1	0.10
Non-compliant project specific surrogate recovery, as specified by USEPA Region 2	Overall Accuracy/Bias	999	9	9	0.90
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	999	1	2	0.20

Minor Data Quality Issues					
Aroclor PCBs Clam Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Aroclor PCB Results Affected
Non-compliant aroclor identification percent difference	Precision	162	6	6	3.70

Minor Data Quality Issues					
Aroclor PCBs Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Aroclor PCB Results Affected
Non-compliant aroclor identification percent difference	Precision	171	12	17	4.09
Received outside of temperature range	Overall Accuracy/Bias	171	3	27	15.8

## Butyltins

The crab and clam program Butyltins dataset is comprised of 111 crab tissue samples with 444 associated results, 18 clam tissue samples with 72 associated results, and 19 sediment samples with 76 associated results.

One major data quality issue was identified during validation of the crab and clam program Butyltins analyses. The identified major data quality issue is described in the table below.

Four minor data quality issues were identified in the crab and clam program Butyltins dataset. The identified minor data quality issues are described in the tables below.

Major Data Quality Issues					
Butyltins Crab Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Butyltins Results Affected
Non-compliant project specific surrogate recovery, as specified by USEPA Region 2	Overall Accuracy/Bias	444	1	4	0.90

Minor Data Quality Issues					
Butyltins Crab Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Butyltins Results Affected
Non-compliant initial calibration regression coefficient	Overall Accuracy/Bias	444	20	42	9.46
Non-compliant continuing calibration percent difference	Overall Accuracy/Bias	444	19	73	16.4
Non-compliant project specific surrogate recovery, as specified by USEPA Region 2	Overall Accuracy/Bias	444	33	132	29.7

Minor Data Quality Issues					
Butyltins Clam Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Butyltins Results Affected
Non-compliant initial calibration regression coefficient	Overall Accuracy/Bias	72	1	1	1.39
Non-compliant continuing calibration percent difference	Overall Accuracy/Bias	72	1	1	1.39

<b>Minor Data Quality Issues</b>					
<b>Butyltins Sediment</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of Butyltins Results Affected</b>
Non-compliant holding time	Representativeness	76	1	4	5.26

As stated in the table above for major data quality issues, four butyltin results were rejected due to surrogate recovery. Surrogate recoveries which resulted in major data quality issues (rejected) fell below 10% recovery.

### Organochlorine Pesticides

The crab and clam program Organochlorine Pesticide dataset is comprised of 111 crab tissue samples with 3219 associated results, 18 clam tissue samples with 522 associated results, and 19 sediment samples with 551 associated results.

One major data quality issue was identified during validation of the crab and clam program Organochlorine Pesticide analyses. The identified major data quality issue is described in the tables below.

Thirteen minor data quality issues were identified in the crab and clam program Organochlorine Pesticide dataset. The identified minor data quality issues are described in the tables below.

<b>Major Data Quality Issues</b>					
<b>Organochlorine Pesticide Crab Tissue</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of Organochlorine Pesticide Results Affected</b>
Non-compliant project specific surrogate recovery, as specified by USEPA Region 2	Overall Accuracy/Bias	3219	69	177	5.50

<b>Major Data Quality Issues</b>					
<b>Organochlorine Pesticide Clam Tissue</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of Organochlorine Pesticide Results Affected</b>
Non-compliant project specific surrogate recovery, as specified by USEPA Region 2	Overall Accuracy/Bias	522	4	7	1.34



<b>Minor Data Quality Issues</b>					
<b>Organochlorine Pesticide Crab Tissue</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of Organochlorine Pesticide Results Affected</b>
Non-compliant ongoing recovery and precision	Precision	3219	5	145	4.50
Non-compliant matrix spike/matrix spike duplicate relative percent difference	Precision	3219	5	13	0.40
Laboratory blank contamination	Accuracy/Bias Contamination	3219	15	15	0.47
Field blank contamination	Accuracy/Bias Contamination	3219	17	47	1.46
Non-compliant identification relative abundance criteria	Overall Accuracy/Bias	3219	97	97	3.01
Non-compliant ion abundance ratio	Overall Accuracy/Bias	3219	2	3	0.09
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	3219	5	17	0.53
Non-compliant internal standard recovery	Overall Accuracy/Bias	3219	29	45	1.40
Non-compliant project specific surrogate recovery, as specified by USEPA Region 2	Overall Accuracy/Bias	3219	79	163	5.06
Non-compliant holding time	Representativeness	3219	5	145	4.50

<b>Minor Data Quality Issues</b>					
<b>Organochlorine Pesticide Clam Tissue</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of Organochlorine Pesticide Results Affected</b>
Non-compliant matrix spike/matrix spike duplicate relative percent difference	Precision	522	1	2	0.38
Laboratory blank contamination	Accuracy/Bias Contamination	522	2	2	0.38
Field blank contamination	Accuracy/Bias Contamination	522	4	27	5.17
Non-compliant identification relative abundance criteria	Overall Accuracy/Bias	522	15	15	2.87
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	522	1	3	0.57
Non-compliant project specific surrogate recovery, as specified by USEPA Region 2	Overall Accuracy/Bias	522	2	3	0.57

<b>Minor Data Quality Issues</b>					
<b>Organochlorine Pesticide Sediment</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of Organochlorine Pesticide Results Affected</b>
Non-compliant matrix spike/matrix spike duplicate relative percent difference	Precision	551	1	1	0.18
Non-compliant field duplicate relative percent difference	Precision	551	2	2	0.36
Laboratory blank contamination	Accuracy/Bias Contamination	551	5	7	1.27
Non-compliant signal to noise ratio	Overall Accuracy/Bias	551	1	18	3.27
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	551	1	1	0.18
Received outside of temperature range	Overall Accuracy/Bias	551	1	29	5.26

As stated in the tables above for major data quality issues, 184 organochlorine pesticide results were rejected due to surrogate recovery. Surrogate recoveries which resulted in major data quality issues (rejected) fell below 10% recovery. Surrogate recoveries which also resulted in major data quality issues (rejected) were surrogate recoveries below 25% with the associated result not detected.

### **Saturated Hydrocarbons**

The crab and clam program Saturated Hydrocarbons dataset is comprised of 19 sediment samples with 665 associated results.

No major data quality issues were identified during validation of the crab and clam program Saturated Hydrocarbons analyses.

Five minor data quality issues were identified in the crab and clam program Saturated Hydrocarbons dataset. The identified minor data quality issues are described in the table below.

<b>Minor Data Quality Issues</b>					
<b>Saturated Hydrocarbon Sediment</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of Saturated Hydrocarbon Results Affected</b>
Non-compliant field duplicate relative percent difference	Precision	665	2	6	0.90
Non-compliant continuing calibration percent difference	Overall Accuracy/Bias	665	6	24	3.61
Non-compliant laboratory control standard recovery	Overall Accuracy/Bias	665	19	163	24.5
Received outside of temperature range	Overall Accuracy/Bias	665	3	105	15.8
Non-compliant holding time	Representativeness	665	1	35	5.26

### Semivolatile Organic Compounds - Selective Ion Monitoring

The crab and clam program SVOCs SIM dataset is comprised of 111 crab tissue samples with 4218 associated results, 18 clam tissue samples with 684 associated results, and 19 sediment samples with 722 associated results.

No major data quality issues were identified during validation of the crab and clam program SVOCs SIM analyses.

Seven minor data quality issues were identified in the crab and clam program SVOCs SIM dataset. The identified minor data quality issues are described in the tables below.

<b>Minor Data Quality Issues</b>					
<b>Semivolatile SIM Crab Tissue</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of SVOC SIM Results Affected</b>
Non-compliant initial calibration relative percent difference	Overall Accuracy/Bias	4218	8	11	0.26
Non-compliant continuing calibration percent difference	Overall Accuracy/Bias	4218	33	53	1.26
Non-compliant project specific surrogate recovery, as specified by USEPA Region 2	Overall Accuracy/Bias	4218	36	177	4.20
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	4218	2	8	0.19

Minor Data Quality Issues					
Semivolatile SIM Clam Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of SVOC SIM Results Affected
Non-compliant initial calibration relative percent difference	Overall Accuracy/Bias	684	14	14	2.05
Non-compliant continuing calibration percent difference	Overall Accuracy/Bias	684	4	4	0.58

Minor Data Quality Issues					
Semivolatile SIM Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of SVOC SIM Results Affected
Non-compliant field duplicate relative percent difference	Precision	722	2	20	2.77
Non-compliant matrix spike/matrix spike duplicate relative percent difference	Precision	722	2	17	2.35
Received outside of temperature range	Overall Accuracy/Bias	722	3	114	15.8
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	722	3	31	4.29

### Metals (including SEM)

The crab and clam program Metals dataset is comprised of 111 crab tissue samples with 2442 associated results, 18 clam tissue samples with 396 associated results, and 19 sediment samples with 532 associated results.

No major data quality issues were identified during validation of the crab and clam program Metals analyses.

Six minor data quality issues were identified in the crab and clam program Metals dataset. The identified minor data quality issues are described in the tables below.

<b>Minor Data Quality Issues</b>					
<b>Metals Crab Tissue</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of Metals Results Affected</b>
Non-compliant laboratory duplicate relative percent difference	Precision	2442	5	14	0.57
Non-compliant matrix pike/matrix spike duplicate relative percent difference	Precision	2442	3	17	0.70
Continuing calibration blank contamination	Accuracy/Bias Contamination	2442	13	16	0.66
Non-compliant interference check sample	Accuracy/Bias Contamination	2442	4	16	0.66
Non-compliant serial dilution	Overall Accuracy/Bias	2442	4	9	0.37
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	2442	7	82	3.36

<b>Minor Data Quality Issues</b>					
<b>Metals Clam Tissue</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of Metals Results Affected</b>
Non-compliant laboratory duplicate relative percent difference	Precision	396	1	1	0.25
Non-compliant interference check sample	Overall Accuracy/Bias	396	14	56	14.1
Non-compliant serial dilution	Overall Accuracy/Bias	396	1	2	0.51

<b>Minor Data Quality Issues</b>					
<b>Metals Sediment</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of Metals Results Affected</b>
Non-compliant laboratory duplicate relative percent difference	Precision	532	2	15	2.82
Non-compliant serial dilution	Overall Accuracy/Bias	532	3	19	3.57
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	532	3	29	5.45

## Titanium

The crab and clam program Titanium dataset is comprised of 111 crab tissue samples with 111 associated results, 18 clam tissue samples with 18 associated results, and 19 sediment samples with 19 associated results.

No major data quality issues were identified during validation of the crab and clam program Titanium analyses.

Three minor data quality issues were identified in the crab and clam program Titanium dataset. The identified minor data quality issues are described in the tables below.

Minor Data Quality Issues					
Titanium Crab Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Titanium Results Affected
Continuing calibration blank contamination	Accuracy/Bias Contamination	111	17	17	15.3

Minor Data Quality Issues					
Titanium Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Titanium Results Affected
Non-compliant laboratory duplicate relative percent difference	Precision	19	1	1	5.26
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	19	3	3	15.8

## Mercury

The Crab and Clam Sampling and Analysis mercury dataset is comprised of 111 crab tissue samples with 111 associated results, 18 clam tissue samples with 18 associated results, and 19 sediment samples with 19 associated results.

No major quality issues were identified during validation of the Crab and Clam Sampling and Analysis mercury analyses.

One minor quality issue was identified during validation of the Crab and Clam Sampling and Analysis mercury analyses. The identified minor data quality issue is described in the table below.

Minor Data Quality Issues					
Mercury Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Mercury Results Affected
Non-compliant field duplicate relative percent difference	Precision	19	2	2	10.5

## Methylmercury

The crab and clam program methylmercury dataset is comprised of 111 crab tissue samples with 111 associated results, 18 clam tissue samples with 18 associated results, and 19 sediment samples with 19 associated results.

One major data quality issue was identified during validation of the crab and clam program methylmercury analyses. The identified major data quality issue is described in the table below.

Three minor data quality issues were identified during validation of the crab and clam program methylmercury analyses. The identified minor data quality issues are described in the tables below.

Major Data Quality Issues					
Methylmercury Crab Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Methylmercury Results Affected
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	111	3	3	2.70

Minor Data Quality Issues					
Methylmercury Crab Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Methylmercury Results Affected
Non-compliant matrix spike/matrix spike duplicate relative percent difference	Precision	111	3	3	2.70
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	111	4	4	3.60

Minor Data Quality Issues					
Methylmercury Clam Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Methylmercury Results Affected
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	18	1	1	5.56

Minor Data Quality Issues					
Methylmercury Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Methylmercury Results Affected
Non-compliant field duplicate relative percent difference	Precision	19	2	2	10.5
Non-compliant matrix spike/matrix spike duplicate relative percent difference	Precision	19	1	1	5.26
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	19	1	1	5.26

As stated in the table above for major data quality issues, three methylmercury results were rejected due to matrix spike/matrix spike duplicate recovery. Matrix spike/matrix spike duplicate recoveries which resulted in major data quality issues (rejected) fell below 10% recovery. Matrix spike/matrix spike duplicate recoveries which also resulted in major data quality issues (rejected) were matrix spike/matrix spike duplicate recoveries above 200% with the associated results detected.

## Cyanide

The crab and clam program Cyanide dataset is comprised of 19 sediment samples with 19 associated results.

One minor data quality issue was identified in the crab and clam program Cyanide dataset. The identified minor data quality issue is described in the table below.

Minor Data Quality Issues					
Cyanide Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Cyanide Results Affected
Non-compliant laboratory duplicate relative percent difference	Precision	19	1	1	5.26



## Hexavalent Chromium

The crab and clam program Hexavalent Chromium dataset is comprised of 19 sediment samples with 19 associated results.

One major data quality issue was identified during validation of the crab and clam program Hexavalent Chromium analyses. The identified major data quality issue is described in the table below.

One minor data quality issue was identified in the crab and clam program Hexavalent Chromium dataset. The identified minor data quality issue is described in the table below.

Major Data Quality Issues					
Hexavalent Chromium Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Hexavalent Chromium Results Affected
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	19	7	7	36.8

Minor Data Quality Issues					
Hexavalent Chromium Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Hexavalent Chromium Results Affected
Received outside of temperature range	Overall Accuracy/Bias	19	3	3	15.8

As stated in the table above for major data quality issues, seven hexavalent chromium results were rejected due to matrix spike/matrix spike duplicate recovery. Matrix spike/matrix spike duplicate recoveries which resulted in major data quality issues (rejected) fell below 50% recovery.

## Sulfide

The crab and clam program Sulfide dataset is comprised of 19 sediment samples with 19 associated results.

One major data quality issue was identified during validation of the crab and clam program Sulfide analyses. The identified major data quality issue is described in the table below.

Three minor data quality issues were identified in the crab and clam program Sulfide dataset. The identified minor data quality issues are described in the table below.

<b>Major Data Quality Issues</b>					
<b>Sulfide Sediment</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of Sulfide Results Affected</b>
Non-compliant holding time	Representativeness	19	1	1	5.26

<b>Minor Data Quality Issues</b>					
<b>Sulfide Sediment</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of Sulfide Results Affected</b>
Non-compliant field duplicate relative percent difference	Precision	19	2	2	10.5
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	19	1	1	5.26
Non-compliant holding time	Representativeness	19	2	2	10.5

As stated in the table above for major data quality issues, one sulfide result was rejected due to non-compliant holding time. Non-compliant holding time which resulted in a major data quality issue (rejected) was result analyzed outside of 2X the holding time.

#### **Polychlorinated Dibenzo-p-dioxins / Polychlorinated Dibenzofurans**

The crab and clam program PCDDs/PCDFs dataset is comprised of 111 crab tissue samples with 1887 associated results, 18 clam tissue samples with 306 associated results, and 19 sediment samples with 323 associated results.

Two major data quality issues were identified during validation of the crab and clam program PCDD/PCDF analyses. The identified minor data quality issues are described in the tables below.

Seven minor data quality issues were identified in the crab and clam program PCDD/PCDF dataset. The identified minor data quality issues are described in the tables below.

<b>Major Data Quality Issues</b>					
<b>PCDDs/PCDFs Clam Tissue</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of PCDD/PCDF Results Affected</b>
Non-compliant project specific labeled analog recovery, as specified by USEPA Region 2	Overall Accuracy/Bias	306	1	1	0.33

<b>Major Data Quality Issues</b>					
<b>PCDDs/PCDFs Sediment</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of PCDD/PCDF Results Affected</b>
Non-compliant ion abundance ratio	Overall Accuracy/Bias	323	4	4	1.24

<b>Minor Data Quality Issues</b>					
<b>PCDDs/PCDFs Crab Tissue</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of PCDD/PCDF Results Affected</b>
Non-compliant continuing calibration percent difference	Overall Accuracy/Bias	1887	5	5	0.26
Non-compliant sample ion ratio	Overall Accuracy/Bias	1887	2	2	0.11

<b>Minor Data Quality Issues</b>					
<b>PCDDs/PCDFs Clam Tissue</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of PCDD/PCDF Results Affected</b>
Non-compliant continuing calibration percent difference	Overall Accuracy/Bias	306	7	8	2.61
Non-compliant sample ion ratio	Overall Accuracy/Bias	306	3	3	0.98
Non-compliant project specific labeled analog recovery, as specified by USEPA Region 2	Overall Accuracy/Bias	306	1	1	0.33

<b>Minor Data Quality Issues</b>					
<b>PCDDs/PCDFs Sediment</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of PCDD/PCDF Results Affected</b>
Non-compliant field duplicate relative percent difference	Precision	323	2	4	1.24
Laboratory blank contamination	Accuracy/Bias Contamination	323	1	3	0.93
Non-compliant sample data calibration range	Overall Accuracy/Bias	323	2	2	0.62
Non-compliant continuing calibration percent difference	Overall Accuracy/Bias	323	1	1	0.31
Non-compliant sample ion ratio	Overall Accuracy/Bias	323	7	9	2.79
Received outside of temperature range	Overall Accuracy/Bias	323	3	51	15.8

As stated in the table above for major data quality issues, five PCDD/PCDF results were rejected due to labeled analog recovery and ion abundance ratios. Labeled analog recoveries which resulted in major data quality issues (rejected) fell below 10% recovery. Labeled analog recoveries which also resulted in major data quality issues (rejected) were surrogate recoveries below 25% with the associated result not detected.

## Polychlorinated Biphenyl Congeners

The crab and clam program PCB Congener dataset is comprised of 111 crab tissue samples with 18648 associated results, 18 clam tissue samples with 3024 associated results, and 19 sediment samples with 3192 associated results.

Two major data quality issues were identified during validation of the crab and clam program PCB Congener analyses. The identified major quality issues are described in the tables below.

Eight minor data quality issues were identified in the crab and clam program PCB Congener datasets. The identified minor data quality issues are described in the tables below.

Major Data Quality Issues					
PCB Congeners Crab Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of PCB Congener Results Affected
Non-compliant continuing calibration relative retention times	Overall Accuracy/Bias	18648	93	733	3.93
Non-complaint ion abundance ratio	Overall Accuracy/Bias	18648	1	1	0.01

Major Data Quality Issues					
PCB Congeners Clam Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of PCB Congener Results Affected
Non-compliant continuing calibration relative retention times	Overall Accuracy/Bias	3024	12	45	1.49
Non-complaint ion abundance ratio	Overall Accuracy/Bias	3024	1	1	0.03

Minor Data Quality Issues					
PCB Congeners Crab Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of PCB Congener Results Affected
Non-compliant matrix spike/matrix spike duplicate relative percent difference	Precision	18648	1	2	0.01
Laboratory blank contamination	Accuracy/Bias Contamination	18648	94	652	3.50
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	18648	4	84	0.45
Non-compliant ongoing precision and recovery	Overall Accuracy/Bias	18648	4	7	0.04
Non-compliant project specific labeled analog recovery, as specified by USEPA Region 2	Overall Accuracy/Bias	18648	16	58	0.31
Non-compliant holding time	Representativeness	18648	7	1176	6.31

Minor Data Quality Issues					
PCB Congeners Clam Tissue	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of PCB Congener Results Affected
Laboratory blank contamination	Accuracy/Bias Contamination	3024	15	39	1.29
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	3024	1	49	1.62
Non-compliant ongoing precision and recovery	Overall Accuracy/Bias	3024	1	1	0.03
Non-compliant project specific labeled analog recovery, as specified by USEPA Region 2	Overall Accuracy/Bias	3024	1	2	0.07

<b>Minor Data Quality Issues</b>					
<b>PCB Congeners Sediment</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of PCB Congener Results Affected</b>
Non-compliant matrix spike/matrix spike duplicate relative percent difference	Precision	3192	1	1	0.03
Non-compliant field duplicate relative to duplicate difference	Precision	3192	2	2	0.06
Laboratory blank contamination	Accuracy/Bias Contamination	3192	15	19	0.60
Non- compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	3192	1	143	4.48
Non-compliant ongoing precision and recovery	Overall Accuracy/Bias	3192	1	1	0.03
Received outside of holding time	Representativeness	3192	3	504	15.8

As stated in the tables above for major data quality issues, 780 PCB congener results were rejected due to continuing calibration relative retention times and ion abundance ratios.

### Chlorinated Herbicides

The crab and clam program Chlorinated Herbicide dataset is comprised of 19 sediment samples with 76 associated results.

No major data quality issues were identified during validation of the crab and clam program Chlorinated Herbicide analyses.

Two minor data quality issues were identified in the crab and clam program Chlorinated Herbicide dataset. The identified minor data quality issues are described in the table below.

<b>Minor Data Quality Issues</b>					
<b>Chlorinated Herbicide Sediment</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of Chlorinated Herbicide Results Affected</b>
Non-compliant Herbicide identification analysis percent difference	Precision	76	1	1	1.32
Received outside of temperature range	Overall Accuracy/Bias	76	3	12	15.8

### Total Organic Carbon (TOC)

The crab and clam program TOC dataset is comprised of 19 sediment samples with 19 associated results.

No major data quality issues were identified during validation of the crab and clam program TOC analyses.

One minor data quality issue was identified in the crab and clam program TOC dataset. The identified minor data quality issue is described in the table below.

Minor Data Quality Issues					
TOC Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of TOC Results Affected
Received outside of temperature range	Overall Accuracy/Bias	19	3	3	15.8

### Oxidation Reduction Potential (ORP)

The crab and clam program ORP dataset is comprised of 19 sediment samples with 19 associated results.

No major data quality issues were identified during validation of the crab and clam program ORP analyses.

Two minor data quality issue was identified in the crab and clam program ORP dataset. The identified minor data quality issues are described in the table below.

Minor Data Quality Issues					
ORP Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of ORP Results Affected
Non-compliant field duplicate relative percent difference	Precision	19	2	2	10.5
Non-compliant laboratory duplicate relative percent difference	Precision	19	2	2	10.5

### Total Extractable Petroleum Hydrocarbon (TEPH)

The crab and clam program TEPH dataset is comprised of 19 sediment samples with 19 associated results.

No major data quality issues were identified during validation of the crab and clam program TEPH analyses.

One minor data quality issue was identified in the crab and clam program TEPH data set. The identified minor data quality issue is described in the table below.

Minor Data Quality Issues					
TEPH Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of TEPH Results Affected
Received outside of temperature range	Overall Accuracy/Bias	19	3	3	15.8

### Total Phosphorus

The crab and clam program Total Phosphorus dataset is comprised of 19 sediment samples with 19 associated results.

No major data quality issues were identified during validation of the crab and clam program Total Phosphorus analyses.

Three minor data quality issue was identified in the crab and clam program sediment Total Phosphorus dataset. The identified minor data quality issues are described in the table below.

Minor Data Quality Issues					
Total Phosphorus Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Total Phosphorus Results Affected
Non-compliant laboratory duplicate relative percent difference	Precision	19	2	2	10.5
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	19	2	2	10.5
Received outside of temperature range	Overall Accuracy/Bias	19	3	3	15.8

### Acid Volatile Sulfide (AVS)

The crab and clam program AVS dataset is comprised of 19 sediment samples with 19 associated results.

Two major data quality issues were identified during validation of the crab and clam program AVS analyses. The identified major data quality issues are described in the table below.

Four minor data quality issues were identified in the crab and clam program AVS dataset. The identified minor data quality issues are described in the table below.



<b>Major Data Quality Issues</b>					
<b>AVS Sediment</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of AVS Results Affected</b>
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	19	1	1	5.26
Received outside of temperature range	Overall Accuracy/Bias	19	1	1	5.26

<b>Minor Data Quality Issues</b>					
<b>AVS Sediment</b>	<b>Data Quality Parameter Affected</b>	<b>Total Number of Results Reported</b>	<b>Number of Samples Affected</b>	<b>Number of Results Affected</b>	<b>% of AVS Results Affected</b>
Non-compliant laboratory duplicate relative percent difference	Precision	19	1	1	5.26
Non-compliant laboratory control sample recovery	Overall Accuracy/Bias	19	1	1	5.26
Non-compliant matrix spike/matrix spike duplicate recovery	Overall Accuracy/Bias	19	1	1	5.26
Received outside of temperature range	Overall Accuracy/Bias	19	2	2	10.5

As stated in the table above for major data quality issues, two AVS results were rejected due to matrix spike/matrix spike duplicate recoveries and sample receipt outside of temperature range. Matrix spike/matrix spike duplicate recoveries which resulted in major data quality issues (rejected) fell below 30% recovery with the associated result not detected. Sample receipt outside of temperature range which resulted in major data quality issues (rejected) was non-detect result in sample received outside of acceptable temperature range.

### **Total Kjeldahl Nitrogen (TKN)**

The crab and clam program TKN dataset is comprised of 19 sediment samples with 19 associated results.

One major data quality issue was identified during validation of the crab and clam program TKN analyses. The identified major data quality issue is described in the table below.

Two minor data quality issues were identified in the crab and clam program TKN dataset. The identified minor data quality issues are described in the table below.

Major Data Quality Issues					
TKN Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of TKN Results Affected
Received outside of temperature range	Overall Accuracy/Bias	19	1	1	5.26

Minor Data Quality Issues					
TKN Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of TKN Results Affected
Non-compliant laboratory duplicate relative percent difference	Precision	19	3	3	15.8
Received outside of temperature range	Overall Accuracy/Bias	19	2	2	10.5

As stated in the table above for major data quality issues, one AVS result was rejected due to sample receipt outside of temperature range. Sample receipt outside of temperature range which resulted in major data quality issues (rejected) was non-detect result in sample received outside of acceptable temperature range.

### Ammonia Nitrogen

The crab and clam program Ammonia Nitrogen dataset is comprised of 19 sediment samples with 19 associated results.

One major data quality issue was identified during validation of the crab and clam program Ammonia Nitrogen analyses. The identified major data quality issue is described in the table below.

No minor data quality issues were identified during validation of the crab and clam program crab and clam program Ammonia Nitrogen analyses.

Major Data Quality Issues					
Ammonia Nitrogen Sediment	Data Quality Parameter Affected	Total Number of Results Reported	Number of Samples Affected	Number of Results Affected	% of Ammonia Nitrogen Results Affected
Received outside of temperature range	Overall Accuracy/Bias	19	3	3	15.8

As stated in the table above for major data quality issues, three ammonia nitrogen results were rejected due to sample receipt outside of temperature range. Sample receipt outside of temperature range which resulted in major data quality issues (rejected) was non-detect results in sample received outside of acceptable temperature range.

## **pH**

The crab and clam program pH dataset is comprised of 19 sediment samples with 19 associated results.

No major or minor data quality issues were identified during validation of the crab and clam program pH analyses.

## **Geotechnical**

The crab and clam program grain size dataset is comprised of 19 sediment samples with 323 associated results.

No major or minor data quality issues were identified during the verification of the crab and clam program grain size analyses.

## **4.0 CONCLUSIONS**

The data usability evaluations outlined in this report provides details regarding the relationship of data quality issues to associated samples and sample results. Ninety-eight (98%) percent of the data validated and reported are suitable for their intended use. A total of 53 sample results for the SVOC were rejected due to surrogate recoveries. A total of four sample results for butyltins were rejected due to surrogate recoveries. A total of 184 sample results for the organochlorine pesticide analyses were rejected due to surrogate recoveries. A total of three sample results for the methylmercury analyses were rejected due to matrix spike/matrix spike duplicate recoveries. A total of seven sample results for the hexavalent chromium analyses were rejected due to matrix spike/matrix spike duplicate recoveries. A total of one sample result for the sulfide analyses was rejected due to hold time violation. A total of five sample results for the PCDD/PCDF analyses were rejected due to labeled analog recovery and ion abundance ratios. A total of 780 sample results for the PCB congeners analyses were rejected due to continuing calibrations relative retention times and ion abundance ratios. A total of two sample results for the AVS analyses were rejected due to matrix spike/matrix spike duplicate recoveries and sample receipt outside of temperature range. A total of one sample result for TKN analyses was rejected due to sample receipt outside of temperature range. A total of three sample results for ammonia nitrogen analyses were rejected due to sample receipt outside of temperature range. Sample results that were rejected are not suitable for project use. Sample results that are qualified as estimated due to multiple minor data quality issues as detailed in this report are suitable for project use. The achievement of the completeness goals for number of samples collected and the number of samples accepted for use provides sufficient quality data to support project decisions.

## **5.0 REFERENCES**

Tierra 2014. Crab and Clam Sampling and Analysis Quality Assurance Project Plan, Revision 3a, August 2014.